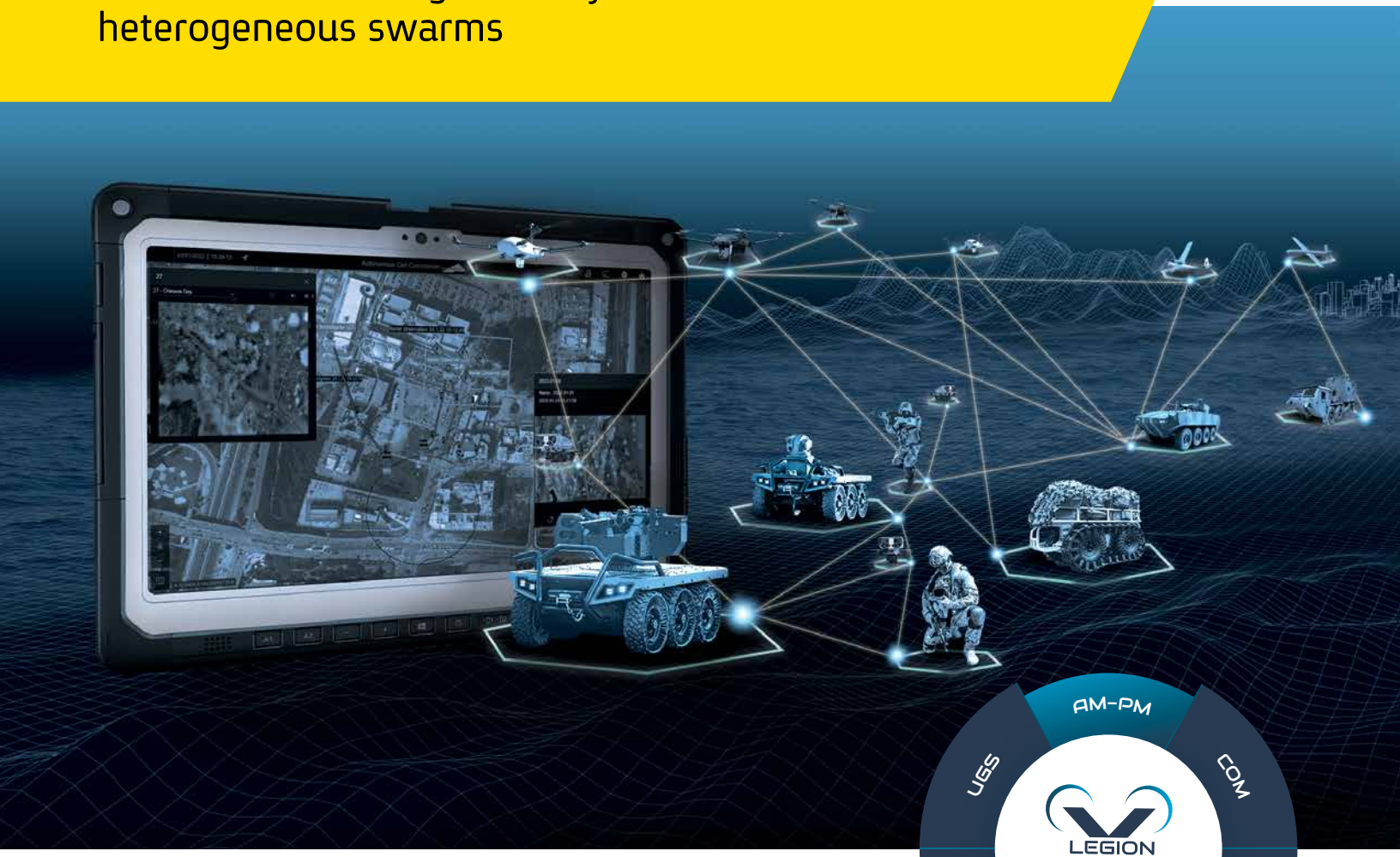
Legion-X AM-PM

Autonomous management system for unmanned heterogeneous swarms



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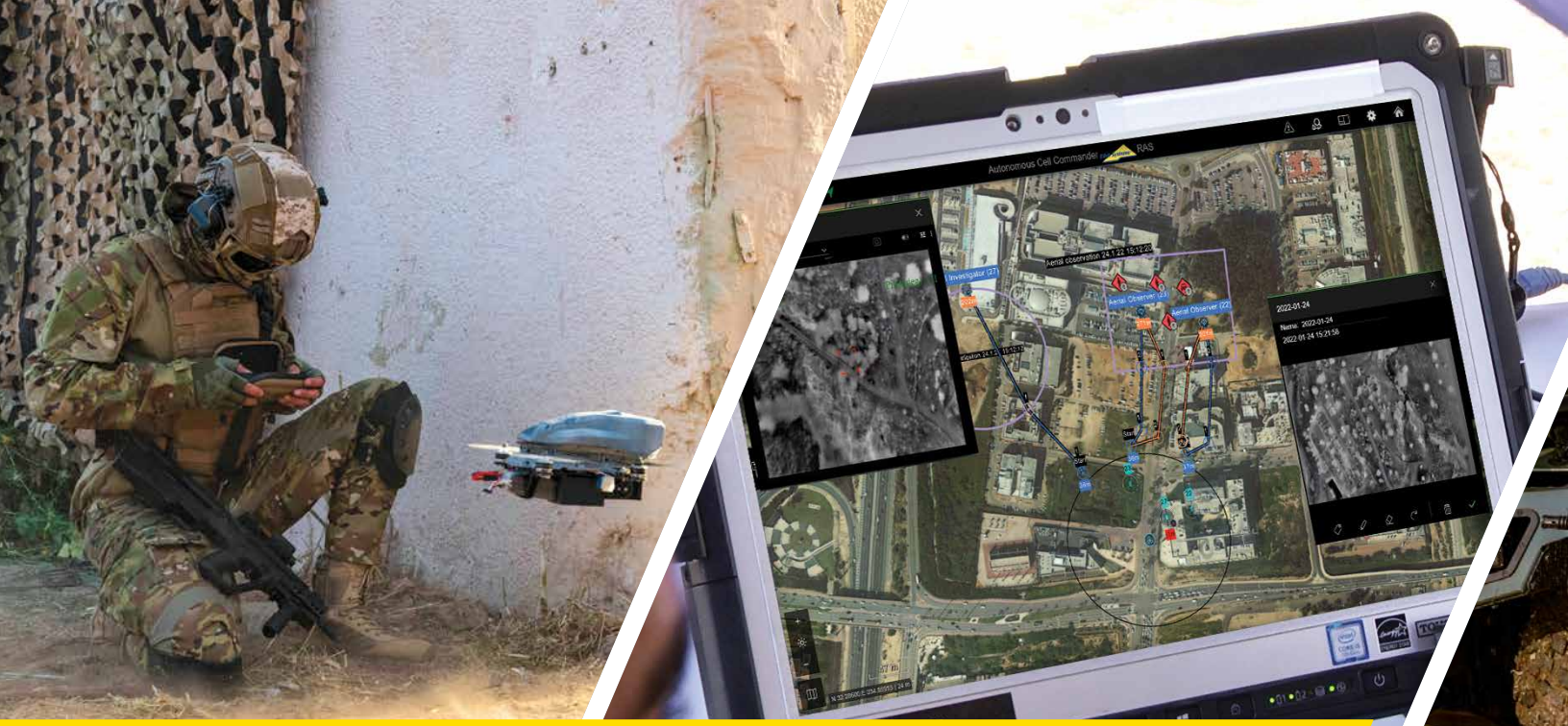

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The increasing use of AI-driven autonomous swarms in multi-domain warfare requires enhanced integration and interoperability with sophisticated, intelligent technologies to expand operational and combat effectiveness. Empowering combat units with a comprehensive solution for mission planning, execution, and management of multiple robotic and autonomous platforms is critical to unleash transformative capabilities. This is particularly relevant in distributed, large-scale autonomous systems, ensuring tactical edge superiority, freedom of maneuver, and mission success with the least possible risk to soldiers.

System Overview

Legion-X AM-PM is a battle-tested, distributed framework for autonomous systems operation that enables the planning, operation, and management of heterogeneous robotic platforms and payloads in multiple domains. The open and robust software stack for autonomous UGV and UAS operations enables capabilities in key domains such as:

Swarm autonomy - encompasses adaptive, complex, collective behaviors for intelligent movement, decisions, and interactions with the environment. Human-swarm teaming highlights the need to interact, influence, and infer swarm system behaviors.

Swarm perception - involves large-scale, distributed, and dispersed sensing, fusion, and distillation of information.

Swarm networking - adaptive, resilient, fragmented sharing and storage of distributed information.

Swarm maintenance addresses hardware and software deployment, support, and maintenance of large-scale systems.

Legion-X AM-PM recommends the optimal swarm composition automatically plotting the route for each platform. The approved mission plan can be modified manually by the operator as needed. The solution links the operational mission to the low-level controllers for onboard device management. It enables multi-asset collaboration featuring a range of services and functionalities, including mission and payload planning and management, navigation and communication, Automatic Target Recognition (ATR), analytics, and sensor fusion. The advanced system comprises multiple software services running on Linux-based commercial off-the-shelf (COTS) hardware modules.

All-in-one: A complete solution from planning to execution, the comprehensive, integrated system supports management, planning, and control and enables communication with the software and hardware onboard the various assets.

Configurable and customizable: The integrated system features a low-code, user-configurable interface.

Open architecture: Legion-X AM-PM features a multi-layered and scalable modular open architecture based on Elbit Systems' E-CiX framework. Most of the interfaces are included in the management system, and all its external interfaces are REST-API-based. The system supports multiple standards, including ROS/ROS2 (open robotics standardization), DDS, JAUS (ground robotics standardization), MAVLink, and more.

Integrated decision management capabilities: The modular and scalable AI-based decision management system (DMS) for dynamic, collaborative planning enables teamwork within distributed systems. The DMS facilitates complex task planning and allocation for effective synchronized mission execution and enables communication among team members.

Legion-X autonomous management (AM): Enables the operator to manage and execute tactical missions performed by a heterogeneous swarm. The system plans missions based on user inputs, including mission type (e.g., force protection, scan and discover, mapping), time and duration (automatic overwatch, hot-swap planning), and location (mission area, takeoff, and landing zones).

Legion-X platform management (PM): Allows the robotic platforms (UGV/UAV) to perform the autonomous mission and collaborate with other swarm members. The module features advanced Edge AI and Edge DMS for distributed platforms with or without constant connection to Legion-X AM.

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Key Benefits

- **Battle-tested:** In operational use worldwide
- **All-in-one:** A complete solution from planning to execution
- **Modular framework:** Multi-layered and scalable
- **Customizable:** Flexible platforms, user-defined missions, and operational use cases

Key Features

- **Open architecture:** Based on Elbit Systems' E-CiX framework
- **Configurable:** Low code interface
- **Decision management system:** Integrated AI-based framework for dynamic, collaborative planning

Supported Standards

Standard	Description
REST API	Most of the interfaces are included in the management system, and all its external interfaces are REST-API-based
WebSocket	Serves for distributing messages from the system servers (mainly) to the browsers
WMTS	A standard protocol (OGC) for streaming mapping entities (Rasters)
WebRTC	A standard protocol for streaming HTTP-based real-time video
Asterix	A standard protocol for sending detections/trajectories
ROS / ROS 2	Robotics open standardization
DDS	A pub/sub-based real-time distribution protocol, serving for communication with the platforms and among the platforms
JAUS	Ground robotics standardization
NMEA	A communication standard for GPS receivers
MAVLink	A standard protocol for communication with drones' controls
OpenCV	Image processing
GSTREAMER	Video coding and processing
Pixhawk	Flight controller

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